

REMARKS

Claim 13 is objected to because it does not further limit independent Claim 8. Claim 13 has been cancelled without prejudice, as set forth above.

Claim Rejections Under 35 USC § 102

Claims 8 - 16 are rejected under 35 USC § 102(b) as being anticipated by U.S. Patent No. 5,039,388, to Miyashita et al. ("the Miyashita reference").

Applicants respectfully contend that the Miyashita reference does not anticipate (or render obvious) applicants' invention as claimed in Claims 8 - 16. The Examiner has argued that the Miyashita et al. reference mentions a maximum particle diameter which falls within the particle distribution range of the high purity aluminum alloy recited as part of applicants' claimed method. In fact, it is impractical to produce large semiconductor processing components using the 1.5 μm maximum particle diameter recited in the Miyashita et al. reference, and applicants' high purity alloy is based on a particle size distribution which permits the presence of larger diameter particles in the alloy. Further, applicants contend that with respect to the physical behavior which is observed for an aluminum alloy, a maximum particle diameter is not indicative of a particle size distribution and is distinctly different in terms of what it teaches. In addition, the Examiner has argued that the Miyashita et al. reference teaches use of an anodic oxidation layer over an aluminum alloy to increase corrosion resistance. However, the corrosion resistance the Miyashita et al. reference is addressing is the corrosion/erosion resistance of the anodized layer itself, and not the corrosion resistance of the aluminum alloy upon which the anodized layer is grown. Applicants' invention relates to an anodized layer produced upon a particular underlying aluminum substrate, where the formation of the anodized layer using the substrate as a starting material prevents or reduces corrosion of the underlying aluminum substrate.

The Examiner cites Col. 2, lines 43 - 44 and 63 - 64 and Col. 3, line 9 of the Miyashita et al. reference. This subject matter including adjacent text, i.e. Col. 2, lines 43 - 48 and lines 60 - 66, and Col. 3, lines 7 - 18 reads as follows: "However, aluminum electrodes having a surface layer formed by anodic oxidation in a bath containing sulfuric acid which are widely used in apparatus for high frequency plasma treatment suffer a heavy reduction in layer thickness due to corrosion during the treatment." . . . "Our further studies have taught us that an anodized layer formed by employing a chromate bath is barely corroded by active fluorine, but is durable for a long period of time without having any substantial reduction in thickness, as opposed to the conventional layer formed by employing a sulfate bath" . . . "The anodized layer formed in a chromate bath not only contributes to the production of a stable plasma, but also is highly resistant to corrosion by active fluorine gas. Such corrosion leads to a reduction in thickness during formation of a film of silicon dioxide or nitride during a wafer As it does not undergo a substantial reduction in its thickness, the (anodized) layer contains few particles that would contaminate a silicon dioxide or nitride film, or hinder its satisfactory etching." (Col. 3, lines 7 - 18.) It is clear that the concern in the Miyashita et al. reference is with changes in the thickness of the anodized layer and particulates which may be generated from the anodized layer corrosion/erosion. This reference does not address the problem which applicants' invention addresses, which is corrosion of the aluminum substrate beneath the anodized layer.

Applicants' invention relates to a high purity aluminum alloy with a controlled particle size distribution and a controlled chemical composition, where particular impurities present in the alloy are not permitted to exceed a maximum nominal amount. These characteristics of the aluminum alloy become important when the concern is formation of an anodized layer which is not porous to reactive species which corrode the underlying aluminum substrate.

There is no teaching or even suggestion in the Miyashita et al. reference about what is happening to the aluminum alloy beneath the anodic oxidation layer. The test for an acceptable anodized layer is the rate at which the anodized layer is corroded/eroded away under process

conditions. (Column 5, lines 8 - 20 -- Table.) The Examiner has failed to make a prima facie case of obviousness with respect to applicants' invention and certainly has not provided evidence that applicants' invention is anticipated by the disclosure in the Miyashita et al. reference.

In more detail, in one of applicants' important applications the protective anodized layer extends the performance lifetime of a semiconductor component exposed to a halogen-containing environment. By controlling the initial particle size distribution and the composition of the high purity aluminum alloy, applicants have been able to reduce the formation of agglomerations of particles within the anodized layer as it grows and at the interface between the anodized protective layer and the underlying aluminum alloy. By controlling the initial particle size distribution in and the composition of the high purity aluminum alloy, so that a proper anodized protective layer is formed over the high purity aluminum alloy, applicants have extended the useful lifetime of a semiconductor apparatus component exposed to the harsh halogen-containing plasmas of the kind used during cleaning of the processing apparatus, for example. The formation of particulate agglomerations at the interface or within the anodized protective layer serve as a stress point which causes cracking and failure of the aluminum oxide protective coating. In addition, since an anodized protective layer grows from the surface of the aluminum alloy, any impurity inclusion located near the alloy surface during formation of the anodized layer will move forward into the anodized layer as the anodized layer grows. Such impurity inclusions are not chemically resistant and are easily attacked by contact with a halogen plasma, creating "tunnels" which lead to the underlying aluminum substrate. Particles generated at the aluminum substrate surface may exit through such tunnels in the anodized layer and generate particulates on semiconductor wafers which are being processed using the processing chamber or component.

In addition to the initial particle size distribution, the composition of the aluminum alloy, notably the maximum concentration of mobile impurities which are present in the alloy, plays a very important role during formation of a protective anodized coating. The migrating impurities

interfere with the formation of the protective anodized layer and may migrate during the lifetime of the semiconductor processing apparatus in a manner which is harmful to semiconductor wafers which are being processed in the apparatus. The migrating impurities which migrate during formation of the anodized layer produce defects in the anodized layer which subsequently cause cracking and tunnel formation which permits halogen species to penetrate to the underlying aluminum alloy substrate. As a result, the underlying aluminum surface becomes corroded, generates particulates, and these particulates exit through the defective anodized layer to deposit on semiconductor device surfaces which are being processed in the apparatus. If the cracking of the anodized layer is severe enough, sections of the anodized layer may flake off, leading to further corrosion and contamination. This is discussed in applicants' Declaration Under 37 C.F.R. §1.132 which accompanies the present Amendment "D".

Applicants are concerned with the amount of particles present over a given range of particle sizes, not just a maximum particle size. If there are a sufficient number of particles present at a particle size which permits the formation of harmful agglomerations during formation of the anodic layer and use of the anodized aluminum article, this will cause the overlying protective anodized layer to fail. Applicants carried out substantial experimentation with respect to the performance value of the protective anodized layer created over the surface of the specialized aluminum alloy which is claimed in their application. The initial experimental results were presented in applicants' patent application as originally filed in Paragraphs 56 and 57. Subsequent to filing of the application applicants carried out further experimentation which is described in detail in applicants' Declaration Under 37 C.F.R. § 1.132 which accompanies the present Amendment "D".

There is nothing in the Miyashita et al. reference which addresses the problem solved by applicants or even suggests the value of the invention which is disclosed and claimed by applicants. As applicants have previously argued, prior to their development of the specialized aluminum alloy described and claimed in their application, there was no material available which offered similar performance in their end use applications.

In light of the above distinctions and the enclosed Declaration under 37 CFR § 1.132, applicants respectfully request withdrawal of the rejection of Claims 8 - 16 under 35 USC § 102(b) over Miyashita et al.

Claim Rejections Under 35 USC § 103

Claims 17, 20, 28, 31, and 32 are rejected under 35 USC § 103(a) as being unpatentable over U.S. Patent No. 6,066,392, to Hisamoto et al. ("the Hisamoto reference"), and Miyashita et al.

Claim 17 is an independent claim which pertains to a method of creating an aluminum oxide (anodized) protective film on the surface of applicants' high purity aluminum alloy (which meets particular requirements for particle size distribution and maximum concentration of particular mobile impurities), using a particular acid electrolyte solution and a particular current density during formation of the anodized film. Claim 20 depends directly (and indirectly) from Claim 17. Claim 28 is an independent claim which pertains to a method of creating an aluminum oxide protective film over the surface of a high purity aluminum alloy which meets particular requirements for the maximum concentration of particular mobile impurities, and employs the electrolyte solution and current density mentioned above for creation of the anodized layer. Claims 31 and 32 depend directly (or indirectly) from Claim 28.

Applicants respectfully contend that the combination of references cited does not render applicants' invention obvious, because the individual references do not even suggest applicants' invention, and therefore a combination of these references cannot render applicants' invention obvious. The Examiner has not met the requirements for a prima facie case of obviousness.

In particular, the Miyashita et al. reference does not anticipate or render obvious applicants' invention for the reasons discussed above with respect to Claims 8 - 16. The Hisamoto et al. reference does relate to the protection of an aluminum alloy substrate by an anodic oxidation film formed over the aluminum alloy surface. However, the focus of the

Hisamoto et al. invention is on the formation of an anodized material which comprises a porous layer, a barrier layer, cells, and secondary-pores wherein the secondary pores are present along cell triple points at which boundary faces of three cells meet. (Col. 3, lines 28 - 38) Particular grain sizes of precipitations in the aluminum alloy are required which precipitations are controlled not only by the composition of the aluminum alloy, but also by use of an annealing process over a particular temperature range followed by a hot rolling process. (Col. 6, lines 45 - 65). The recitation of materials which are acceptable include aluminum alloys which contain element ranges which include as a maximum: 2.0 % magnesium, 2.0 % silicon and 0.3 % copper, for example. (Col. 6, lines 46 - 48) This compares with applicants' aluminum alloy which permits a maximum of 4.0 % magnesium, but requires that the maximum silicon content be less than 0.03 % and that the maximum copper content be less than 0.07 %.

Further, the Hisamoto et al. reference recommends the use of JIS 3003, 5052, and 6061, or other aluminum alloys standardized in accordance with JIS. As applicants previously argued with respect to the Miyashita reference, the Hisamoto reference teaches that use of aluminum alloy compositions which applicants have demonstrated do not work in their apparatus applications. Applicants specifically teach, in their application Specification (as originally filed), that 6061 aluminum alloy (which the Hisamoto et al. reference teaches contains a maximum magnesium content of 1.5 %, silicon content of 1.5 %, copper content of 0.40 %, and chromium content of 0.35 %, at Col. 6, lines 58 - 59) does not provide satisfactory results. In fact, the 6061 aluminum alloy substrate is used to provide comparative results. The maximum magnesium content in the 6061 alloy is below the maximum permitted for the aluminum alloy recited in applicants' claims, while the silicon content is 50 times greater than the maximum silicon content permitted, the maximum copper content is nearly 6 times greater than the maximum copper content permitted, and the maximum chromium content is 5 times greater than the maximum chrome content permitted. Clearly the aluminum alloy which is said to be

acceptable for use in the Hisamoto et al. contains maximum concentrations of particular elements which cause a problem when used in applicants' claimed method.

The kinds of aluminum alloys which are said to be acceptable in both the Miyashita et al. reference and in the Hisamoto et al. reference do not provide an acceptable starting aluminum alloy substrate. Anodization of this substrate does not provide the corrosion resistance which is provided when applicants' specialized high purity aluminum alloy is used as the substrate for anodization. This is further substantiated by the newly added data provided in applicants' Declaration Under 37 C.F.R. §1.132 which accompanies the present Amendment "D".

A combination of the teachings of the Hisamoto reference with those of the Miyashita et al. reference does not teach or even suggest applicants' invention, both because the starting aluminum alloy to be anodized is different, and because these references do not teach or suggest use of the alloy in combination with the anodization solution and applied current density used in applicants' anodization process. It is the combination of all of these process variables which provides a satisfactory result. In addition, the Miyashita et al. reference teaches the use of a chromate bath for anodization (Col. 2, lines 60 - 66), teaching away from applicants' invention; and, the Hisamoto et al. reference teaches that any one of a number of different acids such as oxalic acid, sulfuric acid, boric acid, phosphoric acid, phthalic acid, and formic acid, or mixed aqueous solutions of any one of these acids and sulfuric acid may be used. (Col. 7, lines 64 - 67, continuing at Col. 8, lines 1 - 3). While the Hisamoto et al. reference does mention the potential use of oxalic acid, there is no mention of any specific composition of the acid electrolyte and no mention of the current density applied to the acid electrolyte composition. Both of these process variables are recited both in applicants' independent Claims 17 and 28 because they are required to achieve the desired result in terms of formation of a protective aluminum oxide film over the specialized aluminum alloy substrate. Both of these references teach away from applicants' invention by teaching the use of a substrate which has been demonstrated to produce an

anodized layer which fails under the test conditions illustrative of the performance required from components produced for applicants' end use applications.

In light of the above distinctions, applicants respectfully request withdrawal of the rejection of Claims 17, 20, 28, 31, and 32 under 35 USC § 103(a) over Hisamoto et al. and Miyashita et al.

Claims 18 - 20 and 29 - 32 are rejected under 35 USC § 103(a) as being unpatentable over Hisamoto et al. and Miyashita et al., as applied to claims above, in view of XP-002244144 ("the XP'144 reference").

Claim 18 - 20 depend directly or indirectly from Claim 17. Claims 29 - 32 depend directly or indirectly from Claim 28. The Miyashita et al. and Hisamoto et al. references alone or in combination do not render these claims obvious for the reasons provided above with respect to the rejection of Claims 17 and 28.

This XP'144 reference is not identified as to source or date, but appears to be text taken from some general publication regarding aluminum, surface treatment of aluminum, and uses for aluminum. In applicants' previously submitted Amendment "C", applicants requested that the Examiner identify the source of the printed matter and the date on which the XP'144 reference was published. Applicants note that the Examiner has not yet provided this information. Applicants therefore refute this reference as an applicable under 35 USC § 103(a) until the Examiner identifies the source of the printed matter and the date on which it was published.

The XP'144 reference appears to be a general reference which includes a description of surface treatment methods, including anodizing processes which can be used to convert an aluminum surface to aluminum oxide. Once again, the anodization processes are said to be applicable to a number of aluminum alloys, including 1100, 2011, 2014, 2017, 2024, 2117, 3003, 3004, 5005, 5050, 5052, 5056, 5357, 6053, 6061, 6063, 6151, and 7075, for example. It

is not possible to cite the page number of the article on which these wrought alloys are listed, because there are no page numbers on the reference document. Again, with respect to the XP'144 reference (as with respect to the Miyashita and Hisamoto references), the aluminum alloy starting materials contain maximum concentrations of particular mobile elements which are harmful during the formation of the anodic protective layer and harmful during the functioning of the anodized aluminum component over the lifetime of the component.

While it might be obvious to try known anodic coating formation methods on any aluminum alloy surface, it is not obvious which coating formation method on which aluminum alloy surface will provide a satisfactory result. For this reason, "obvious to try" is not the standard for obviousness under 35 USC § 103. This is particularly true in the present instance, where the method of forming the anodic coating requires the use of a specific anodization solution composition in combination with a specific DC current density which combination is not recited in any of the art cited. "The mere need for experimentation to determine parameters needed to make a device work is an application of the often rejected obvious-to-try standard and falls short of the statutory obviousness of 35 U.S.C. §103." (*Uniroyal Inc. v. Rudkin-Wiley Corp.*, 837 F.2d 1044, 5 U.S.P.Q.2d 1434 (Fed. Cir. 1988).) "An 'obvious-to-try' situation exists when a general disclosure may pique the scientist's curiosity, such that further investigation might be done as a result of the disclosure, but the disclosure itself does not contain a sufficient teaching of how to obtain the desired result or indicate that the claimed result would be obtained if certain directions were pursued." (*In re Eli Lilly & Co.*, 902 F.2d 943, 14 U.S.P.Q. 2d 1741 (Fed.Cir. 1990).) In addition, in the present instance, there is no suggestion that use of a specialized aluminum alloy substrate of the kind described and claimed by applicants will provide an improved transition from the aluminum alloy surface to the aluminum oxide layer which improves the performance of an anodized article, as claimed in Claims 17 and 28, and claims which depend therefrom.

Since none of the three references cited teaches or even suggests the use of a specialized aluminum alloy of the kind described by applicants, where the surface of that alloy is treated using a specific electrolytic oxidation process of the kind described and claimed by applicants, a combination of these three references does not direct one skilled in the art toward applicants' invention.

In view of the above distinctions, applicants respectfully request withdrawal of the rejection of Claims 18 - 20 and 29 - 32 under 35 USC § 103(a) over Hisamoto et al. and Miyashita et al., in view of XP-002244144.

Claims 24, 25, 33, and 34 are rejected under 35 USC § 103(a) as being unpatentable over Hisamoto et al. and Miyashita et al., in view of Japanese Patent Publication No. 08-311594 ("the JP'594 reference").

The deficiencies of the disclosures of the Hisamoto and Miyashita references with respect to the patentability of the presently claimed invention are discussed in detail above with respect to the rejection of Claims 17, 20, 28, 31, and 32.

Claims 24 and 25 depend directly or indirectly from Claim 17, and Claims 33 and 34 depend directly or indirectly from Claim 28. Each of Claims 24, 25, 33, and 34 recite that, prior to creating the aluminum oxide protective film on the high purity aluminum alloy surface, the aluminum alloy is heat treated to relieve stress and increase hardness, where the heat treatment is carried out at a temperature of 330°C or at a lower temperature.

The JP'594 reference is cited by the Examiner as teaching the annealing of an Al-Mg alloy at a temperature within the range of 200 - 260°C. The focus of the disclosure is on providing an aluminum-magnesium sheet which has excellent bendability and involves a first annealing process followed by cold rolling, followed by a final annealing process. The drawings

pertain to the bendability of an aluminum-magnesium sheet. The tensile strength of the alloy is discussed. There is no disclosure in the abstract regarding the composition of the aluminum alloy other than a minimum concentration of magnesium which is present. There is no mention of a particle size distribution in the abstract. There is no mention of use of a protective coating over a surface of the aluminum-magnesium alloy for protection of the alloy. Addition of the general subject matter which is present in the abstract of the disclosure to the subject matter which is present in the Hisamoto and Miyashita et al. references will not contribute the missing teachings which would be required to render obvious applicants' invention. Applicants contend that Claims 24, 25, 33, and 34 are patentable over the combination of the Hisamoto, Miyashita, and JP'594 references for the same reasons that Claims 17, 20, 28, 31, and 32 are patentable over the Hisamoto and Miyashita references. In particular, none of the three references cited teaches or even suggests the use of a specialized aluminum alloy of the kind described by applicants, where the surface of that alloy is treated in the manner claimed and then electrolytically oxidized to provide an improved transition from the aluminum alloy surface of a protective oxide layer which is formed by the method. A combination of these three references does not direct one skilled in the art toward applicants' invention.

In light of the above distinctions, applicants respectfully request withdrawal of the rejection of Claims 24, 25, 33, and 34 under 35 USC § 103(a) over Hisamoto et al. and Miyashita et al., in view of Japanese Patent Publication No. 08-311594.

Applicants contend that the claims as amended are in condition for allowance, and the Examiner is respectfully requested to enter the requested amendment and to pass the application to allowance.

The Examiner is invited to contact applicants' attorney with any questions or suggestions, at the telephone number provided below.

Respectfully submitted,

A handwritten signature in cursive script, reading "Shirley L. Church", written over a horizontal line.

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